

**Characterization of Sealed Anodic Layers on  
7050 T74 and 2214 T6 Aluminum Alloys**

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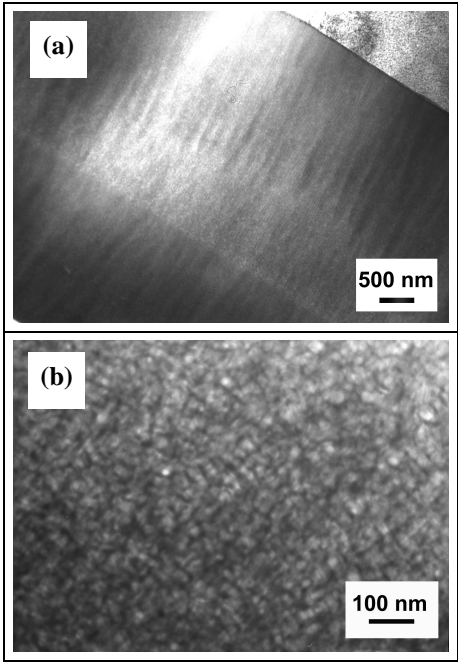
Anodic films developed on 7050 T74 and 2214 T6 aluminum alloys by anodization in sulfuric acid and sealed in Ni and Co acetate solution were observed by scanning (SEM) and transmission (TEM) electron microscopies and analyzed by X-ray photo-electron (XPS), secondary ion mass (SIMS) and glow-discharge optical emission (GDOES) spectroscopies to correlate the microstructure of these anodic layers to their corrosion behavior in 0.1 M NaCl solution.

Recently, spectroscopic investigations have been applied on sealed anodic films in order to have a better understanding of oxide growth and sealing mechanisms by determining elemental depth line profiles in the oxide films, particularly surface enrichment in sealing bath additives [1]. Many studies have shown that electrochemical impedance spectroscopy could be successfully applied to evaluate the sealing quality of the anodized surface [2].

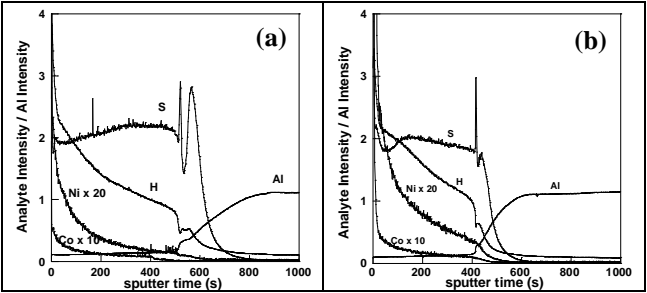
As for pure aluminum, columnar structure was clearly observed on the TEM micrographs for 7050 alloy unsealed anodized layer (Fig. 1a). For 2214 alloy, TEM cross-sections of the unsealed anodized layer confirmed the disorganized morphology of the oxide layer which appeared as a spongy structure (Fig. 1b). This difference of morphology between the two alloys may be explained by the greater number of coarse intermetallic particles in the 2214 alloy.

GDOES depth profiles of sealed anodic films grown on 7050 and 2214 alloys are presented in Figure 2. Incorporation of Ni and Co species is not uniform throughout the film. Indeed, enrichment in the outer regions of the films can be observed. Sulfur seems to be uniformly distributed throughout the oxide film but a sulfur peak is clearly observed close to the metal/oxide interface which origin is not yet determined. Compared to 7050 alloy, Ni and Co contents are higher for 2214 alloy. This may be linked to the more porous structure for the 2214 alloy. Hydrogen depth profile provided qualitative information about hydration extent through the oxide layer. It seems that hydration of the layer is more pronounced at the outer surface layers.

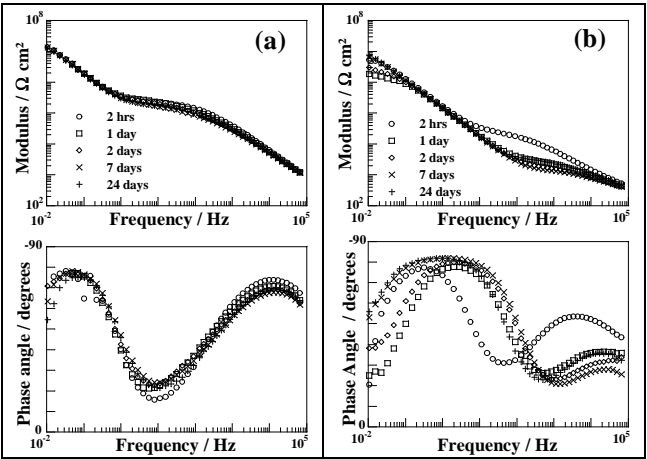
For 7050 alloy, the impedance spectra remain stable during the immersion time (Fig. 3a). Good corrosion resistance was observed since only a few small pits was detected at the end of the exposure. For 2214 alloy, the decrease of the modulus (Fig. 3b) in the medium frequency range indicates a drastic enhancement of the ionic conduction along the pores due to the degradation of the sealed porous layer.



**Figure 1:** Cross-section TEM micrographs of unsealed anodized (a) 7050 and (b) 2214 Al alloys.



**Figure 2 :** GDOES depth profiles of sealed anodic films on (a) 7050 and (b) 2214 Al alloys.



**Figure 3 :** Impedance diagrams as a function of the immersion time in 0.1 M NaCl for (a) 7050 and (b) 2214 Al alloys anodized in a sulfuric acid bath and sealed in a Ni and Co acetate solution.

References :  
[1]. O.J. Murphy, J.S. Wainright, J.J. Lenczewski, J.H. Gibson, and M.W. Santana, J. Electrochem. Soc. , **136**, 3518 (1989)  
[2]. J. Hitzig, K. Juettner, W.J. Lorenz and W. Paatsch, J. Electrochem. Soc., **133**, 887 (1986)